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Biochemical Research Laboratory

The Dow Chemical Company

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EXPOSURE TO FINE DUSTS ENCOUNTERED
BY WORKERS CUTTING VARIOUS TYPES OF
PIPE COVERING MATERIAL

File: T2.1-3-1
Date: July 21, 1965
By: E. J. Schneider

Signed E. J. Schneider Date 7/22/65

Checked H. R. Hoyle Date 7-22-65

DOW CONFIDENTIAL PROBLEM

A question was raised by shop personnel after reading an article of the health hazards associated with exposure to asbestos. Is there a health hazard from asbestos in cutting various types of pipe covering material used at Dow Corning? The Environmental Research Laboratory was asked to evaluate the exposures to the fine dusts encountered by workers cutting the pipe covering material and to determine the possible health hazard.

CONCLUSIONS

1. Concentrations of total dust in excess of acceptable levels can be encountered by workers cutting pipe covering material both by hand and in using a table saw.
2. A total dust count or the number of particles per million cubic feet of air also exceeds acceptable levels at times.
3. The amount of asbestos fibers of significant length found within the dust exceeds 25 per cent of the fiber content,



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however, fibers constitute only 10 per cent of the total dust. The possibility that Dow Corning workers are being exposed to excessive amounts of asbestos fibers within the important fiber lengths (20-50 microns) is unlikely, however, it is advisable and prudent to have workers wear respiratory protection while cutting pipe covering material. This is especially true when using a table saw.

4. No one type of pipe covering material was found to have a significantly greater amount of asbestos fibers than the others. The Phillip Carey FiberCel material does produce considerable more fine dust than the others when cut.

ASBESTOS

In reviewing the literature⁽¹⁾ it is learned that the most common form of asbestos is known as chrysotile, a hydrous magnesium silicate containing from 12.5 to 14 per cent water of crystallization. There is another form of asbestos derived from amphibole which occurs as a variety of minerals consisting of iron, calcium and magnesium silicates with little water of constitution. This latter type of asbestos consists of shorter fibers but is more stable chemically than chrysotile and more resistant to acids and heat.

⁽¹⁾ Industrial Toxicology - L. T. Fairhall, pp. 19-21, 1957.

It is this latter type of asbestos which is thought to be used in the various pipe covering material tested because x-ray diffraction analysis of the materials showed them to contain tobermorite, a calcium silicate form of asbestos.

The inhalation of asbestos dust produces a condition known as asbestosis. Asbestos is the only silicate apart from talc and mica which does not contain free silica and yet produces pulmonary lung fibrotic changes. The fibrogenic action differs from silica in that the effects are produced only by long asbestos fibers. Very short fibers appear to have little or no effect. The long fibers apparently block the finer bronchioles of the lungs and produce fibrotic changes as a result of irritation.

The literature⁽¹⁾ states that in the case of asbestosis unlike silicosis fibrosis does not progress indefinitely after cessation of exposure. It further states that in order to produce asbestosis in workers exposures must be in excess of 5 millions particles cubic foot for extended periods (greater than 10 years) and the fibers in the range of 10-250 μ in length. Some authorities indicated that only those asbestos fibers in the 20-50 μ range are significant for producing asbestosis.

The present Industrial Hygiene Standards state that for control the number of particles of asbestos dust be kept below

⁽²⁾ Industrial Hygiene and Toxicology - Frank A. Patty, Vol. I, pp. 398-399, 1958.

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5 mpcf and that for nuisance dusts of any type the number of particles must be below 50 mpcf or 15 mgs total dust per cubic foot of air.

PRESENTATION OF DATA

Early in 1965 a visit was made to Dow Corning to make measurements of the dust exposures encountered by workers cutting pipe covering material. In a small room (approximately 10' x 15') adjacent to the pipe shop building 409 a worker was asked to hand saw several pieces of the various types of pipe covering material used at Dow Corning. Air samples were collected in his breathing zone while sawing the materials. Analyses were made for both total dust and the number of particles of dust in the contaminated air.

In another small room (approximately 8' x 6') part of the pipe shop building 316 tests were repeated for two different pipe covering materials while a worker used a table saw to cut the materials.

At both locations only general ventilation was used with no local exhaust system for dust collection.

The air samples collected for total dust load were later sent to Dow laboratories for x-ray diffraction analysis and then microscopic evaluation.

Table 1 shows a summary of the results obtained for the air samples by the various analytical techniques.

Table I

EXPOSURE TO PINE DUSTS ENCOUNTERED BY WORKERS CUTTING VARIOUS TYPES OF PIPE COVERING MATERIALS

Industrial Hygiene Standard, Nuisance Dusts . . . 15 mg/m³
 Industrial Hygiene Standard, Asbestos Fibers . . . 5 M.P.C.P.

Operation	Total Dust Exposure	(Dust Count)	X-Ray Diffraction Analysis	Electron Microscope Analysis		(Fibers 10% of Total Dust)		
	mg/m ³	M.P.C.P.		Particle Size		Fiber	Size	10-50 μ
Prestrapping zone of worker hand sawing Baldwin Forest Hill asbestos flat block 2" thick	0.45	3.2	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	35%	<10 μ	1%	<10 μ	25%
		8.4		95%	<20 μ	5%	<20 μ	
		44.6				7.4	>50 μ	
Repeat same material	0.09	12.6	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	45%	<10 μ	5%	<10 μ	45%
				90%	<20 μ	10%	<20 μ	
						1.4	>50 μ	
Avg.		14.5						
Hand sawing Owens-Corning Kaylo flat block 2" thick	3.50	17.3	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	45%	<10 μ	1%	<10 μ	25%
		22.2		90%	<20 μ	5%	<20 μ	
						7.4	>50 μ	
Avg.		19.8						
Hand sawing Phillips Carey Fibersol curved block 2" thick	17.90	7.9	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	45%	<10 μ	5%	<10 μ	45%
		12.1		90%	<20 μ	10%	<20 μ	
						1.4	>50 μ	
Avg.		10.0						
Hand sawing Phillips Carey 35% flat curved block 2" thick	7.20	11.0	3MgCO ₃ . Mg(OH) ₂ . 3H ₂ O	35%	<10 μ	1%	<10 μ	25%
				95%	<20 μ	5%	<20 μ	
						7.4	>50 μ	
Hand sawing Baldwin Forest Hill asbestos flat block 2" thick	0.09	13.5	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	45%	<10 μ	5%	<10 μ	45%
				95%	<20 μ	10%	<20 μ	
						1.4	>50 μ	
Prestrapping zone of worker using table saw to cut Owens-Corning Kaylo flat block 2" thick	77.90	--	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	45%	<10 μ	1%	<10 μ	5%
				90%	<20 μ	5%	<20 μ	
						1.4	>50 μ	
Main table saw to cut Baldwin Forest Hill asbestos flat block 2" thick	53.90	53.5	Tobermorite (0.5-1.5) CaO . SiO ₂ . (0.5-2.0) H ₂ O	35%	<10 μ	1%	<10 μ	25%
				95%	<20 μ	5%	<20 μ	
						7.4	>50 μ	

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The total dust exposure is not excessive in hand sawing most of the types of pipe covering material, however, sawing the Phillip Carey Fibercei® material does produce a very fine dust and does produce excessive concentrations of dust.

The use of the table saw as would be expected produces very large quantities of dust even for a not too dusty material such as the Baldwin Ehret Hill Unibestos®.

The dust count in millions of particles per cubic foot did exceed in all cases the 5 mpcf Industrial Hygiene Standard for asbestos. However, because asbestos fibers represent approximately 10% of the total dust and because only approximately 25% of the fibers are considered of significant size, it is doubtful that workers encounter a health hazard in their normal work load of cutting pipe covering material.

The practice of using a table saw either within a shop building or out in the field should not be continued without adequate control of the dust or the use of respiratory devices. It also seems advisable to encourage workers to wear respiratory protection when hand sawing material. Any Bureau of Standards approved dust respirator should prove adequate to filter out the asbestos fibers.

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UNIT INDEX

Measurements were made of the dust exposures encountered by workers cutting pipe covering material, Pipe Shop Department, Dow Corning Corporation, Midland, Michigan. Concentrations of total dust in excess of acceptable levels can be produced both in hand sawing and in the use of a table saw. The amount of asbestos fibers found did not constitute a health hazard. Respiratory protection is recommended to be worn when cutting pipe covering material.

DISTRIBUTION

Jack Quinn, Safety Department, Dow Corning Corporation (4)
H. H. Gay, M.D., Medical Department, 607 Building
A. W. Wilson, Safety Department, 401 Building
R. C. Middleton, Safety Department, Ludington Division
W. Snodgrass, Maint. Service Admin., 49 Building (7/9/71)

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TO: E. J. Schneider



THE DOW CHEMICAL COMPANY

MIDLAND, MICHIGAN

ANALYTICAL LABORATORIES

REPORT

DATE 20 May 1965

CHARGE 700-4400-003

AL NUMBER S 57-945

PROBLEM _____

YOUR NUMBER _____

DESCRIPTION HYDRATED CALCIUM SILICATE ON LATEX FILTERS

MICROSCOPY

Particle size determination

About 65%	< 10 μ
About 90%	< 20 μ
0	> 50 μ

Filters 1, 5, 6, 8

About 85%	< 10 μ
About 95%	< 20 μ

Filters 2, 3, 4, 7

About 45%	< 10 μ
About 90%	< 20 μ

Fiber size determination

About 1%	< 10 μ
About 10 %	< 20 μ
About 65%	> 50 μ

Filters 7

About 1%	< 10 μ
About 2%	< 20 μ
About 90 %	> 50 μ

Filters 2, 4, 6

About 5%	< 10 μ
About 10 %	< 20 μ
About 45%	> 750 μ

Filters 1, 3, 5, 8

About 1%	< 10 μ
About 5%	< 20 μ
About 70 %	> 50 μ

Fibers would account for about 10 % of the residue

SPL. 8 REL. 12 DET. 20

BY R. Lape
bb

SIGNED P. A. Traylor

PHONE MSG. 2351 BLDG. 574

PHOTOMICROGRAPHY

ALS 57-945

Photomicrographs were prepared employing Bright field x

Phase Contrast Oblique Transmitted Light

Dark field Polarized Light Oblique Reflected Light technique

to show particles and fibers

Label Data for 8 x 10 prints x
 contact prints

<u>Negative #</u>	<u>Sample</u>	<u>Microscopy</u>	<u>Magnif</u>
L5-525	Latex Filter # 2	B. F.	300X
L5-526	Latex Filter # 8	B. F.	300X

THE DOW CHEMICAL COMPANY
CHEMICAL PHYSICS RESEARCH LABORATORY

REPORT NUMBER 168499

TO
E. J. Schneider

DEPARTMENT
Biochem Res. Lab.

SHIPPING NUMBER
1701

SUBJECT

X-ray Diffraction Analysis of dust samples from cutting pipe
covering at Dow Corning

CHARGE NO.

1219-26

DATE RECEIVED

2-2-65

SIGNED

H. W. Rinn

DATE

2-11-65

- #1 (.0001 g) Tobermorite - $X\text{CaO} \cdot \text{SiO}_2 \cdot y\text{H}_2\text{O}$ where x varies between 0.8 and 1.5 and y between 0.5 and 2.0
- #2 (>.0001 g) Same as #1
- #3 (.0004 g) Same as #1
- #4 (.0020 g) Same as #1
- #5 (.0008 g) This sample gave a very weak pattern of hydromagnesite - $3\text{MgCO}_3 \cdot \text{MgOH} \cdot 3\text{H}_2\text{O}$. There could be amorphous material present.
- #6 (<.0001 g) Tobermorite and some calcite. Pattern quite weak, probably because of small sample.
- #7 (.0052 g) Mainly tobermorite with 10-20% calcite - CaCO_3 .
- #8 (.0036 g) Mainly tobermorite with 5-10% calcite.

No quartz was detected in any of the samples.

Note on appearance of tobermorite - from Crystallographic Data for the Calcium Silicates by Heller and Taylor.

Natural mineral from Ballycraigy: minute, radiating aggregates of fibers with distinctive silky lustre on the cleavage faces.

Natural mineral from Mull or Skye: fine geared aggregates of minute, birefringent crystals.

Synthetic material: minute irregular crystals, birefringent.

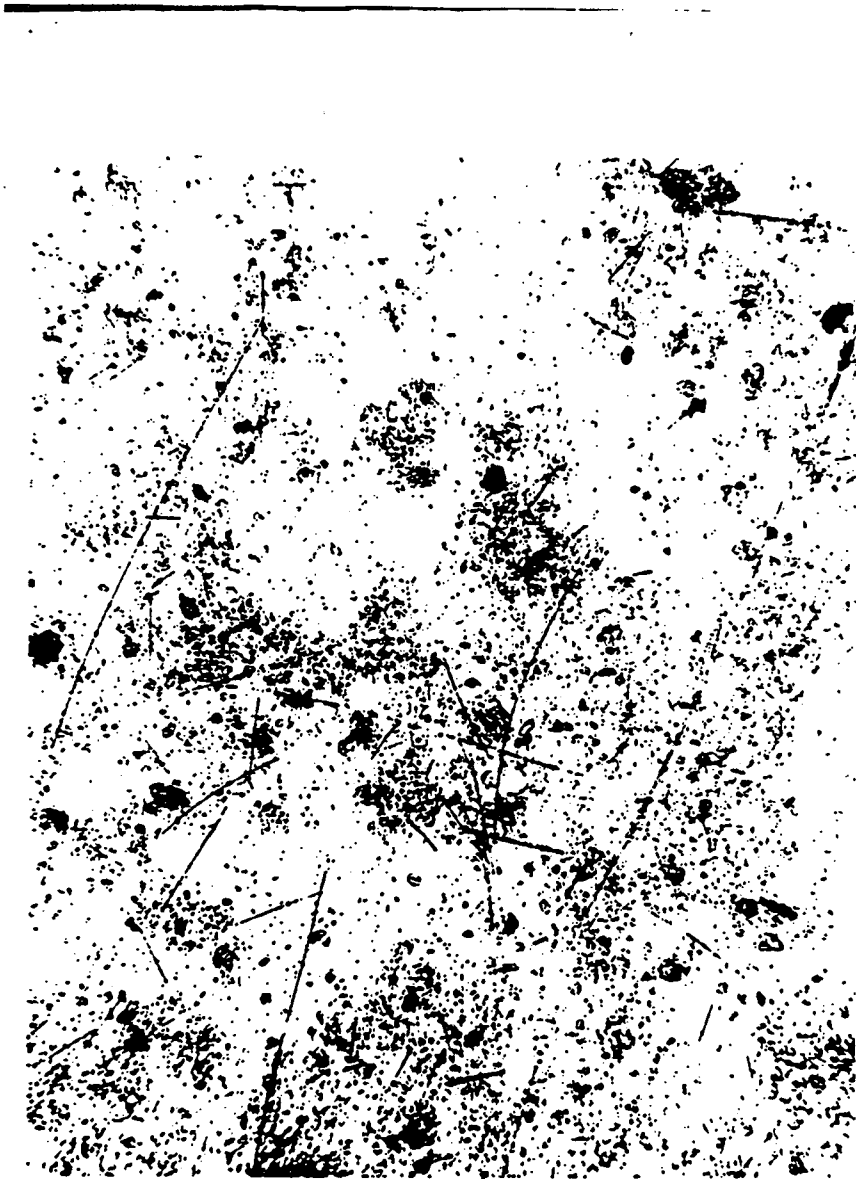
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Table I
EXPOSURE TO FINE DUSTS ENCOUNTERED BY WORKERS CUTTING
Industrial Hygiene Standard, Nuisance
Industrial Hygiene Standard, Asbestos Fibers

Operation	(Total Dust Exposure)	(Dust Count)	X-Ray Diffraction
	mg/m ³	M.P.C.P.	
Breathing zone of worker hand sawing Baldwin Ehret Hill calcium silicate curved block 2" thick	0.45	3.2 6.4 4.8 44.6	Tobermorite (0.8-1.5) CaO . SiO ₂
Repeat same material	0.09	12.6	Tobermorite (0.8-1.5) CaO . SiO ₂
	Avg.	14.5	
Hand sawing Owens-Corning Kaylo flat block 2" thick	3.60	17.3 22.2	Tobermorite (0.8-1.5) CaO . SiO ₂
	Avg.	19.8	
Hand sawing Phillip Carey Fibercel curved block 2" thick	17.90	7.9 12.1	Tobermorite (0.8-1.5) CaO . SiO ₂
	Avg.	10.0	
Hand sawing Phillip Carey 85% MAG curved block 2" thick	7.20	11.0	3MgCO ₃ . Mg(OH) ₂ . 3H ₂ O
Hand sawing Baldwin Ehret Hill Unibestos flat block 2" thick	0.09	14.5	Tobermorite (0.8-1.5) CaO . SiO ₂
Breathing zone of worker using table saw to cut Owens-Corning Kaylo flat block 2" thick	77.90	--	Tobermorite (0.8-1.5) CaO . SiO ₂
Using table saw to cut Baldwin Ehret Hill Unibestos flat block 2" thick	53.90	54.6	Tobermorite (0.8-1.5) CaO . SiO ₂

10 VARIOUS TYPES OF FIBER COVERING MATERIALS

Dusts 15 mg/m³
 Fibers 5 M.F.C.F.

Fiber	Fiber Analysis	Electron Microscope Analysis		(Fibers 10% of Total Dust)		
		Particle Size		Fiber	Size	20-50 μ
10 ₂	(0.5-2.0) H ₂ O	85%	<10 μ	1%	<10 μ	25%
		95%	<20 μ	5% 70%	<20 μ >50 μ	
10 ₂	(0.5-2.0) H ₂ O	45%	<10 μ	5%	<10 μ	45%
		90%	<20 μ	10% 45%	<20 μ >50 μ	
10 ₂	(0.5-2.0) H ₂ O	45%	<10 μ	1%	<10 μ	25%
		90%	<20 μ	5% 70%	<20 μ >50 μ	
10 ₂	(0.5-2.0) H ₂ O	45%	<10 μ	5%	<10 μ	45%
		90%	<20 μ	10% 45%	<20 μ >50 μ	
3H ₂ O	3H ₂ O	85%	<10 μ	1%	<10 μ	25%
		95%	<20 μ	5% 70%	<20 μ >50 μ	
10 ₂	(0.5-2.0) H ₂ O	85%	<10 μ	5%	<10 μ	45%
		95%	<20 μ	10% 45%	<20 μ >50 μ	
10 ₂	(0.5-2.0) H ₂ O	45%	<10 μ	1%	<10 μ	8%
		90%	<20 μ	2% 90%	<20 μ >50 μ	
10 ₂	(0.5-2.0) H ₂ O	85%	<10 μ	1%	<10 μ	25%
		95%	<20 μ	5% 70%	<20 μ >50 μ	

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INDUSTRIAL HYGIENE SAMPLE RECORD

SAMPLING METHOD <i>Filter</i>	SAMPLE RATE <i>22.72/min</i>	PROBLEM <i>T2.1-3-1</i>	BLOC.	DATE <i>1/29/65</i>
TRAPPING MEDIUM <i>Gallium City Filter</i>	ROTAMETER OR ORIFICE NO. <i>Pump #1</i>	PROCESS <i>DOW CORNING SHOPS</i>		
ROTAMETER SETTING	OUTSIDE TEMP.	INSIDE TEMP.	MATERIAL <i>ASBESTOS.</i>	

VENTILATION

Blg 409 cupola shop: none approx 10X15 cm restriction

Blg 316 pipe shop: small none with shop 8x8 cm restriction

SAMPLE	BOTTLE	DESCRIPTION	TIME		CONCENTRATION
			START	STOP	
2131 -1	<i>Filter #1</i>	<i>BZ hand sawing Brehm Chest Mill</i> <i>Column Silica Cemented 2" thick</i>			
2131 -2	<i>Filter #2</i>	<i>Same material.</i>		<i>5 min</i>	
2131 -3	<i>Filter #3</i>	<i>BZ hand sawing Owens Corning Kaylor</i> <i>2" flat block.</i>		<i>5 min</i>	
2131 -4	<i>Filter #4</i>	<i>BZ hand sawing Philly Corv Filtered</i> <i>2" flat block. very fine dust.</i>		<i>5 min</i>	
2131 -5	<i>Filter #5</i>	<i>BZ hand sawing Philly Corv 85% Mg</i> <i>2" curved block</i>		<i>5 min</i>	
2131 -6	<i>Filter #6</i>	<i>BZ hand sawing Brehm Chest Mill</i> <i>Uncoated 2" flat block.</i>		<i>5 min</i>	
2131 -7	<i>Filter #7</i>	<i>BZ many tasks saws bly 3/16 to cut</i> <i>Owens Corning Kaylor 2" flat block</i> <i>very dusty</i>		<i>3 min</i>	
2131 -8	<i>Filter #8</i>	<i>BZ many tasks saws bly 3/16 to cut</i> <i>Brid. Uncoated 2" flat block.</i> <i>very dusty</i>		<i>3 min</i>	

CALCULATIONS RECORD

[illegible]

INDUSTRIAL HYGIENE SAMPLE RECORD

SAMPLING METHOD B+L DUST COUNTER.		SAMPLE DATE		PROJECT T2-3-1		BLDG.		DATE 1/29/65	
TRAPPING METHOD			ROTAMETER OR ORIFICE NO.			PROCESS DW CREAMING SHOPS			
ROTAMETER SETTING		OUTSIDE TEMP.		INSIDE TEMP.		MATERIAL ASBESTOS			

VENTILATION: Breathing zone of worker wearing gas mask; paper covers mouth

[illegible]

SI 0000586